

Confirmation No. 5647

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	HUETING	Examiner:	Kuo, W.
Serial No.:	10/562,254	Group Art Unit:	2826
Filed:	December 20, 2005	Docket No.:	GB030096US1
Title:	TRENCH MOS STRUCTURE		

BRIEF ON APPEAL

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No. 65913

Dear Sir:

This Appeal Brief is submitted pursuant to 37 C.F.R. §41.37, in support of the Notice of Appeal filed April 29, 2008 and in response to the rejections of claims 1-10 as set forth in the Final Office Action dated January 30, 2008 and in acknowledgment of the Advisory Action dated April 21, 2008.

Please charge Deposit Account number 50-0996 (NXPS.323PA) \$510.00 for filing this brief in support of an appeal as set forth in 37 C.F.R. §1.17(c). If necessary, authority is given to charge/credit Deposit Account 50-0996 additional fees/overages in support of this filing.

I. Real Party In Interest

The real party in interest is NXP Semiconductors. The application is presently assigned of record, at reel/frame nos. 017416/0898 to Koninklijke Philips Electronics, N.V., headquartered in Eindhoven, the Netherlands. We have been authorized by both the assignee of record and NXP Semiconductors to convey herein that the entire right, title and interest of the instant patent application have been transferred to NXP Semiconductors.

II. Related Appeals and Interferences

While Appellant is aware of other pending applications owned by the above-identified Assignee, Appellant is unaware of any related appeals, interferences or judicial proceedings that would have a bearing on the Board's decision in the instant appeal.

III. Status of Claims

Claims 1-10 stand rejected and are presented for appeal. A complete listing of the claims under appeal is provided in an Appendix to this Brief.

IV. Status of Amendments

No amendments have been filed subsequent to the Final Office Action dated January 30, 2008.

V. Summary of Claimed Subject Matter

Appellant's recited invention relates to semiconductor devices that include trench structures.

Commensurate with independent claim 1, an example embodiment of the present invention is directed to a semiconductor device having opposed first and second major surfaces, the device including a body region at the first major surface (*see, e.g.*, body 4 defining surface 16 as shown in Fig. 2, along with page 6:21-23), at least one cell having longitudinally spaced source and drain implantations extending into the body region from the first major surface (*see, e.g.*, source implantation 22 and drain implantation 23 shown

in Fig. 2, along with page 6:23-25), the source and drain implantations being spaced away from the substrate by part of the body region and defining a channel part of the body region between the source and drain implantations (*see, e.g.*, channel region 40 shown in Fig. 2, along with page 6:23-25), and at least one insulated gate trench extending longitudinally from the source implantation to the drain implantation through the body region (*see, e.g.*, insulated gate trench 42 illustrated in Fig. 3, along with page 7:3-9), the insulated gate trench including a gate conductor insulated from the source and drain implantations and the body region by a gate dielectric along the side and end walls and the base of the trench (*see, e.g.*, gate conductor 54 illustrated in Fig. 2, along with page 7:16-20), the source and drain implantations extending along part of the side walls of the trench (*see, e.g.*, Figs. 2 and 3, along with page 7:6-9), and wherein the source and drain implantations include conductive shallow contact regions at the first major surface extending vertically into the body to a depth of no more than 35% of the depth of the trench (*see, e.g.*, shallow contact regions 26 and 28 shown in Fig. 2, along with page 3:25-32 and page 6:26-30).

As required by 37 C.F.R. § 41.37(c)(1)(v), a concise explanation of the subject matter defined in the independent claims involved in the appeal is provided herein. Appellant notes that representative subject matter is identified for these claims; however, the abundance of supporting subject matter in the application prohibits identifying all textual and diagrammatic references to each claimed recitation. Appellant thus submits that other application subject matter, which supports the claims but is not specifically identified above, may be found elsewhere in the application. Appellant further notes that this summary does not provide an exhaustive or exclusive view of the present subject matter, and Appellant refers to the appended claims and their legal equivalents for a complete statement of the invention.

VI. Grounds of Rejection to be Reviewed Upon Appeal

The grounds of rejection are listed below.

A. Claims 1-3 and 5-10 stand rejected under 35 U.S.C. § 103(a) over Hueting '348 (U.S. Patent No. 6,515,348) in view of Dennen (U.S. Patent No. 6,555,872).

B. Claim 4 stands rejected under 35 U.S.C. § 103(a) over Hueting '348 in view of Dennen and further in view of Hueting '823 (U.S. Patent No. 6,534,823).

VII. Argument

As set forth below, Appellant submits that the claimed invention is allowable over the cited references because the obviousness rejections are based on a combination of references that fails to provide correspondence the claimed invention, and for which no valid reason to combine has been demonstrated. A purported obviousness rejection based on a combination of references fails unless the references are properly combinable and teach or suggest all the recited claim elements. Without a reasonable expectation of success and a valid reason for combining, references are not properly combinable. These conditions cannot be satisfied when a reference teaches away from the proposed combination or modification, or a reference is rendered inoperable for its intended purpose upon making the proposed combination or modification. Appellant submits that the Examiner's obviousness rejections fail to meet the required criteria.

A. The § 103(a) rejection of claims 1-3 and 5-10 over Hueting '348 in view of Dennen is improper and should be reversed.

1. The proposed combination of Hueting '348 with Dennen does not correspond to all the features of the claims.

Appellant submits that the Hueting '348 and Dennen references taken alone or in combination do not disclose all of the features recited in Appellant's claims. In particular, neither reference discloses the claimed aspects directed to source and drain

implantations including conductive shallow contact regions. Additionally, the Hueting '348 reference discloses a mesa structure, not a trench structure, and therefore fails to provide correspondence to source and drain implantations that define a channel between them in the manner recited in Appellant's claims. Such a distinction is important not only for demonstrating a failure to correspond to Appellant's claims, but also for raising serious questions about the Examiner's purported reasons to combine the references, as discussed in more detail in part 2 below.

The Examiner acknowledges that the Hueting '348 reference fails to teach source and drain implantations that include conductive shallow contact regions, asserting instead that the source and drain regions 123 and 124 shown in Dennen's Fig. 9 are shallow contact regions. However, before Dennen's source and drain regions 123 and 124 can be considered shallow contact regions, one must first find source and drain implantations that incorporate the regions 123 and 124. To this end, the Examiner erroneously asserts that Dennen's undepleted portion 122a, shown in Fig. 11A, forms a deeper portion of both the source and drain regions. Closer inspection of the Dennen reference reveals that undepleted portion 122a is part of the tub region 122 which is formed underneath both of the source and drain regions 123 and 124. According to Dennen, "the width and doping level of the undepleted portion 122a of the tub 122 under the drain region 124 can be 'tuned' to serve as a vertical drift region." *See, e.g.,* Dennen Col. 23:22-26. As such, Dennen teaches that the undepleted portion 122a is part of tub 122, and that the undepleted portion 122a serves as a drift region. Dennen does not teach or suggest that undepleted portion 122a functions as a deeper part of the source and drain regions 123 and 124, but rather is part of the tub 122. Clearly, the tub 122 cannot be considered to be a functional part of the source and drain regions because this would result in the source and drain regions being shorted.

The Examiner asserts that Appellant's arguments regarding non-correspondence between the teachings of Dennen and the claimed shallow contact regions relies merely on the fact that Dennen does not use the words "shallow contact region" to describe the source and drain regions 123 and 124. Such an assertion mischaracterizes Appellant's arguments. Appellant has observed, as an initial matter, that Dennen describes source and drain regions 123 and 124 as source and drain regions, and includes no description of

shallow contact regions. Appellant's arguments then proceeded to demonstrate that the undepleted portion 122a and tub 122 do not function as deeper portions of the source or drain regions. Thus, Appellant's responses have not been limited to arguing the manner in which Dennen has chosen to describe structural elements, but also on the functions that those structural elements perform. In both cases, Dennen fails to teach shallow contact regions such as recited in Appellant's claims.

Accordingly, neither the Hueting '348 reference nor the Dennen reference teach source and drain implantations that have conductive shallow contact regions. Furthermore, neither reference teaches shallow contact regions that extend to a depth of no more than 35% of the depth of the trench as recited in Appellant's claims. The Examiner has continually asserted that Appellant has not established the criticality of the ratio of the depth of the shallow contact regions to the depth of the trench. However, Appellant notes that the Examiner must first present a *prima facie* case of obviousness before Appellant is required to show the criticality of a claimed range. *See, e.g.*, M.P.E.P. § 2144.05 ("In the case where the claimed ranges 'overlap or lie inside ranges disclosed by the prior art' a *prima facie* case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976)"). The Examiner has not presented a *prima facie* case of obviousness because the Examiner has not cited to any reference that teaches source and drain implantations that have conductive shallow contact regions that extend to a depth that overlaps with the claimed depth.

For at least these reasons, the proposed combination of Hueting '348 with Dennen does not teach or suggest all the features recited in Appellant's claims. Accordingly, the § 103(a) rejection of claims 1-3 and 5-10 is improper, and Appellant requests that it be reversed.

2. The Hueting '348 and Dennen references are not combinable in the manner proposed.

Appellant submits that the Hueting '348 and Dennen references are not combinable in the manner proposed because no function would be served by accommodating shallow contact regions as claimed into the structure of Hueting '348.

Furthermore, the Examiner has provided no valid reason to combine the Hueting '348 and Dennen references, contrary to the requirements of § 103 and relevant law ("A patent composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art." *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (U.S. 2007).)

The Examiner asserts that one of skill in the art would modify the teachings of Hueting '348 to incorporate shallow contact regions "for the benefit of maximizing the breakdown voltage of trench gate Fermi-FET transistors" as taught by Dennen (*see* page 4 of the Final Office Action). In reference to Fig. 9 (reproduced below), Hueting '348 shows a mesa structure in which the source and drain electrodes S and D each extend vertically along the entire source and drain regions 5 and 6, respectively (*see, e.g.*, Col. 6:61-64). It would serve no function to include shallow contact regions that extend vertically into the regions 5 and 6 as claimed since the source and drain electrodes would still make contact with the entire source and drain regions, including any shallow contact regions along with portions that are not the shallow contact regions. Thus, including such regions would have no effect on breakdown voltage as speculated by the Examiner. Moreover, Hueting '348 already provides for the formation of regions 30S and 30D to extend the source and drain regions into layers, which serves to isolate the source and drain electrodes S and D from the substrate. As such, one of skill in the art would find no reason to modify Hueting '348 by adding shallow contact regions for the purpose of additional isolation from the substrate.

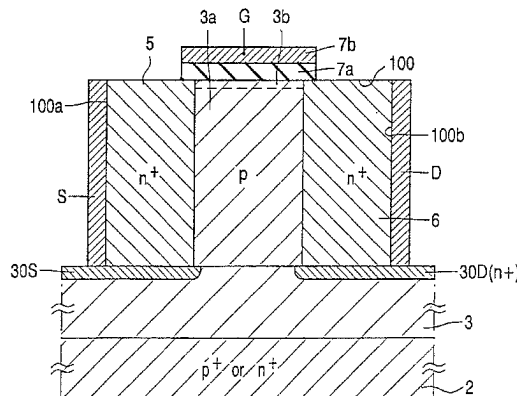


Figure 9 Hueting '348

Appellant further observes that the function of maximizing the breakdown voltage as disclosed by Dennen is directed to the tub structure disclosed by Dennen. For example, Dennen teaches that the source and drain regions 123 and 124 can be made shallow enough to allow a region of low concentration N silicon to exist above the junction between the tub 122 and well 123 (*see, e.g.*, Dennen's Fig. 9 reproduced below, along with Col. 26:38-41). In contrast, the Hueting device does not have a structure that corresponds to Dennen's tub 122. As such, the Examiner has not demonstrated that Hueting '348 would benefit from the teachings of Dennen as asserted (*i.e.*, that the proposed combination would maximize the breakdown voltage of Hueting '348).

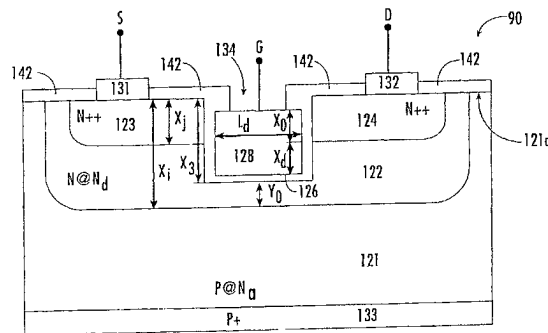


Figure 9 Dennen

In light of the above discussions, it is unclear to Appellant how the Examiner is proposing to combine the teachings of Hueting '348 with Dennen, and the Examiner has not provided any detail. For example, the Examiner has not specified where the shallow contact regions are to be incorporated into the Hueting device, or whether or how Dennen's tub region 122 is to be incorporated into the Hueting device. The Examiner has merely stated that, regardless of whether or not Hueting's device has a structure that corresponds to Dennen's tub, Hueting's device can still benefit from a conductive shallow contact region to maximize the breakdown voltage (*see, e.g.,* Advisory Action). However, the Examiner has not provided any evidence as to how the proposed combination would maximize the breakdown voltage of Hueting '348 without Dennen's tub structure and corresponding functionality.

Appellant submits that the statements made by the Examiner amount to no more than conclusory statements of generalized advantages and convenient assumptions about

skilled artisans. Such statements and assumptions are inadequate to support a finding of motivation, which is a factual question that cannot be resolved on subjective belief and unknown authority. Thus, the Examiner relies upon improper conclusory statements in asserting obviousness, thereby directly contradicting M.P.E.P. § 2142 which states that “rejections on obviousness cannot be sustained with mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *See, also KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (U.S. 2007).

For at least these reasons, Appellant submits that the Hueting ‘348 and Dennen references are not combinable in the manner proposed, and that insufficient reason to combine has been provided by the Examiner. Accordingly, the § 103(a) rejection of claims 1-3 and 5-10 is improper, and Appellant requests that it be reversed.

B. The § 103(a) rejection of claim 4 over Hueting ‘348 in view of Dennen and further in view of Hueting ‘823 is improper and should be reversed.

Appellant respectfully submits that the Hueting ‘823 reference provides no teaching or disclosure to overcome the underlying deficiencies set forth above with respect to the proposed combination of Hueting ‘348 with Dennen. In at least this regard, the § 103(a) rejection of claim 4 is improper, and Appellant requests that it be reversed.

VIII. Conclusion

In view of the above, Appellant submits that the rejections of claims 1-10 are improper. Appellant therefore requests reversal of the rejections as applied to the appealed claims and allowance of the entire application.

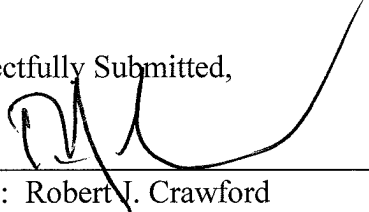
Authority to charge the undersigned's deposit account was provided on the first page of this brief.

Please direct all correspondence to:

Corporate Patent Counsel
NXP Intellectual Property & Standards
1109 McKay Drive; Mail Stop SJ41
San Jose, CA 95131

CUSTOMER NO. 65913

Respectfully Submitted,

By: 
Name: Robert J. Crawford

Reg. No.: 32,122

Robert J. Pechman

Reg. No.: 45,002

Tel: 651 686-6633 ext. 2300

(NXPS.323PA)

APPENDIX OF CLAIMS INVOLVED IN THE APPEAL
(S/N 10/562,254)

1. A semiconductor device having opposed first and second major surfaces, comprising:
 - a body region at the first major surface;
 - at least one cell having longitudinally spaced source and drain implantations extending into the body region from the first major surface, the source and drain implantations being spaced away from the substrate by part of the body region and defining a channel part of the body region between the source and drain implantations; and
 - at least one insulated gate trench extending longitudinally from the source implantation to the drain implantation through the body region, the insulated gate trench including a gate conductor insulated from the source and drain implantations and the body region by a gate dielectric along the side and end walls and the base of the trench, the source and drain implantations extending along part of the side walls of the trench, wherein the source and drain implantations include conductive shallow contact regions at the first major surface extending vertically into the body to a depth of no more than 35% of the depth of the trench.
2. A semiconductor device according to claim 1 wherein the body region is of first conductivity type and the shallow contact regions are of a second conductivity type opposite to the first conductivity type.
3. A semiconductor device according to claim 1 or 2 wherein each of the source and drain implantations further comprises a lower doped region of lower doping than the shallow contact region.
4. A semiconductor device according to claim 3, wherein:

the source implantation includes a higher doped shallow source contact region and a lower doped source drift region between the higher doped source contact region and the body;

the drain implantation includes a higher doped shallow drain contact region and a lower doped drain drift region between the higher doped drain contact region and the body;

the insulated gate trench includes potential plate regions extending longitudinally on either side of a central region, the potential plate regions being adjacent to the source and drain drift regions respectively, and the central region being adjacent to the body; and

the thickness of the gate dielectric sidewalls of the insulated gate trench is greater in the potential plate regions of the insulated gate than the central region.

5. A semiconductor device according to claim 1 comprising a plurality of cells laterally spaced across the first major surface.
6. A semiconductor device according to claim 5 wherein gate trenches alternate with the plurality of cells laterally across the first major surface.
7. A semiconductor device according to claim 5 wherein each cell has a gate trench laterally within the confines of the cell.
8. A semiconductor device according to claim 3 wherein the lower doped region of lower doping than the shallow contact region extends vertically below the shallow contact region to a depth at least 80% of the depth of the trench.
9. A semiconductor device according to claim 1, wherein the source and drain implantations consist exclusively of the shallow contact region.
10. A semiconductor device according to claim 1 on a conductive substrate of first conductivity type.

APPENDIX OF EVIDENCE

Appellant is unaware of any evidence submitted in this application pursuant to 37 C.F.R. §§ 1.130, 1.131, and 1.132.

APPENDIX OF RELATED PROCEEDINGS

As stated in Section II above, Appellant is unaware of any related appeals, interferences or judicial proceedings.